



## **National Monitoring Programme for Biodiversity in Libya**

Contract n° 09\_EcAp MED II SPA/RAC\_2016

# National monitoring programme for Biodiversity in Libya

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## **List of Acronyms**

**ACCOBAMS:** Agreement on the Conservation of Cetaceans in the Mediterranean, black sea and adjacent Atlantic Area

**AEWA:** Agreement on the conservation of African – Eurasian Migratory waterbirds

**AFFSL:** Artisanal Fishery Friends Society, Libya (AFFSL)

**ASWMB:** Alhayat Society for wildlife and marine biology

**CI:** Common indicator

**COPEMED:** Coordination to support Fisheries Management in the western and Central Mediterranean

**EcAp:** Ecosystem Approach

**EO:** Ecological objective

**EGA:** Environment General Authority

**FAO:** Food and agriculture Organization

**GAMW:** General Authority for marine wealth

**GES:** Good Environmental Status

**GFCM:** General Fisheries Council for the Mediterranean

**ICCAT:** International commission for the conservation of Atlantic Tuna

**IMAP:** Integrated monitoring and assessment programme

**LARST:** Libyan Authority for Research, Science and Technology

**LBS:** Libyan Biological Society

**LOS:** Libyan Oceanography Society

**LSB:** Libyan Society for Birds

**LWT:** Libyan Wildlife Trust

**MAP:** Mediterranean Action Plan

**MARPOL:** International Convention for the Prevention of Pollution

**MBRC:** Marine Biology Research Centre

**MEDRAP:** Mediterranean Regional Aquaculture Project

**MWS:** Marine wealth sector

**RIS:** Ramsar Information Sheet

**SELAM:** Socio- Economic and Legal Aspects

**SPA/RAC:** Specially Protected Areas Regional Activity Centre

**SOLAS:** International Convention for the Safety of Life at Sea

**UNCED:** United Nation Conference on Environmental and Development

**UNEP:** United Nation Environment Programme

**NAFIMCO:** National Fishing & Marketing Company

**NUCLOS:** United Nations Convention on the Law of the Sea

## **Exclusive summary**

The Libyan coast extends for about 2000 kilometres and it occupies about 36% of the southern coast of the Mediterranean. Several monitoring and research programs have been carried out in Libya, targeting; water birds, sea turtles, monk seals, fisheries, coastal habitats and alien species. Most of these programs funded by national or international agencies but they were either short termed or of opportunistic nature. However, there are still some wide knowledge gabs especially regarding cartilaginous species conservation, habitats hotspots, cetaceans and alien species. Some of the needs that Libya consider as priorities are; rectifying and updating the current legislations relevant to biodiversity, increase capacity building effort in the different fields of conservation, and produce national action plan for the relevant indicators. More effort is also needed in establishing collaboration between regional organizations and researchers in the Mediterranean basin, as well as to establish a network of collaboration platforms for the exchange of information and experiences.

## **Introduction**

The Mediterranean Sea is one of the marine biodiversity hotspots. Marine fauna and flora have evolved over millions of years among a unique group of temperate and tropical species with a high proportion of stable species (28%) (Zupanovic and El-Buni, 1982). Bathymetrically, three areas may be distinguished along the Libyan coast of the Mediterranean; all are closely associated with major structural features of the African continent. The first and largest of these areas contains a relatively even central terrace of about 50.000 km<sup>2</sup> extension to the Gulf of Gabes. It has a depth of less than 200m, while its slope is less than 1%. The two other areas are deeper (Sogreah, 1977). The most northerly area consists of an underwater basin of particularly rugged relief connected to the Pantelleria and Linosa trenches. The other area, east of the longitude 13 E, forms the Tripolitania pre-continent which joins the Libyan land mass to Malta and Medina banks by a ridge varying in depth from 200 to 500m. The Tripolitania pre-continent is a fairly even area at a depth always greater than 200m. It is cut into two large but narrow underwater valleys, one from Tripoli running SE to NW and the other one closer to Medina bank. Along the coast, a series of fairly regular rocky ledges is to be found down to a depth of about 30m, a platform which is concealed in certain places by sand deposits of varying thickness. The eastern part of the Libyan coast, including the Gulf of Sirte and Cyrenaica, is mainly rocky and the continental shelf is steep and narrows (Zupanovic and El-Buni, 1982). The Cyrenaican continental slope is also faulted and folded it forms a 6 narrow and steep continental margin which is separated from the Mediterranean Ridge by an elongated, narrow and deep furrow with water depths between 2500-3000 m. This furrow may represent a scar of a major fault system which runs offshore parallel to the Cyrenaican coast and is referred to as the N Cyrenaica Fault System. Published swath bathymetry and seismic reflection data suggest that the Cyrenaican continental slope is being differentially overthrust by the Mediterranean Ridge. This is regarded as an incipient continental collision process (Huguen and Mascle, 2001).

## **Background**

Marine environments and habitats have suffered from different kinds of pressure due to human activities which requires a sustainable management of the natural resources for a better conservation of the marine ecosystems and its biodiversity at the national and regional level. In this regard, the Contracting parties to the Barcelona convention, including Libya, have adopted the ecosystem approach (EcAp) to the management of human activities and have committed to a road map for its implementation in the Mediterranean with the ultimate objective of achieving the good environmental status (GES) of the Mediterranean Sea and Coast.

The EcAp is a strategy for the integrated management of land, water and living resources that promoted conservation and sustainable use in an equitable way. As such, it is the guiding principle to all policy implementation and development undertaken under the auspices of UNEP/MAP Barcelona Convention.

This process aims to achieve the GES through informed management decisions, based on integrated quantitative assessment and monitoring of 11 Ecological objectives (EO) and their respective common indicators.

Furthermore, the contracting parties to the Barcelona Convention have adopted, based on the decision IG.22/7<sup>1</sup>, the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP).

In the framework of the implementation of the next steps of the EcAp roadmap, SPA/RAC has committed to support the southern Mediterranean countries, including Libya, in developing their national monitoring programmes related to biodiversity in line with the IMAP recommendations. The objective of this present report is to develop a reference document for the implementation of a national programme for the monitoring and assessment of marine and coastal biodiversity in Libya. This programme is mainly related to biodiversity (OE1), non-indigenous species (OE2) and fisheries (OE3).

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<sup>1</sup> [http://www.rac-spa.org/sites/default/files/doc\\_cop/decision\\_22.07\\_en.pdf](http://www.rac-spa.org/sites/default/files/doc_cop/decision_22.07_en.pdf)

## I. Legislative Framework

### 1. Libyan legislation

There are successive issuances of legislations that have been issued in Libya for the protection of the environment; including law 14 of 1989 concerning the use of marine wealth and its supplements i.e. decision 71/90 concerning the legal interpretation of law 14 of 1989 and decision 80/1991 concerning the technical interpretation of law 14 of 1989. Such legislations are mostly focused on the causes of pollution. Although, Libya faced little issues related to pollution caused by industrial activities as the case in many countries. These issues included a high concentration of the population in the coastal zones which led to acute depletion of natural resources due to urbanization, reclamation of ground water and desertification (Libyan National Biodiversity Strategy, 2002). A summary list of key laws and decisions that have been issued since the establishing of Marine wealth sector is given in table (1).

**Table. 1. Libyan legislation and decrees**

<b>MWS</b>	<b>Contents – Effect</b>
• Law number 7 / 1982	Regarding the protection of environment. The third chapter addressed the protection of marine biology and the hazards of oil pollution on fish species
• Act number 25 / 1950	For protection of forests
• Law number 12 / 1956	For forest organizing
• Law number 47 / 1971,	For the protection of forests and pastures.
• Law number 5 / 1982	Related to the protection of forests and pastures; amended by Law No. 14 / 1992.
• Act number 3 / 1984	Issued by General People’s Committee of Agriculture and land reclamation concerning the protection of grasslands and forests from fire.
• Law number 15 / 1984	For preventing the overhunting of wild animals
• Law 14 – 1989	Basic legislation to establish marine wealth sector competition and regulation of marine wealth use and preservation
• Decision No. 106 – 1988	To Establish basis and procedures for providing subsidies and encouragement to operators in the

	national marine fisheries
• Decision No. 5 – 1990	Provision for custom duty exemption for fishing gear and equipment
• Decision No. 71 – 1990	Elaborates provision of Law 14 and procedures of its legal interpretations
• Act number 11 / 1990	Issued by the General People’s Committee concerning the establishment of Technical Committee for Wildlife, which conferred upon the technical and administrative supervision on the protected areas and national parks
• Decision No. 80 – 1991	Provides technical explanations and specifications for the implementation of Law 14 (mentioned above)
• Decision No. 17 1991	To prohibit contracts with foreign owned companies fishing in Libyan waters or using any foreign vessels to exploit marine wealth in Libyan territorial waters. To stipulate that licenses for the use of marine wealth should be issued to Libyan nationals only.
• Law No. 23 -1991	Basic legislation authorizing creation and operation of fishing cooperation
• Decision No. 7 – 1992	Elaborates provisions and procedures pertaining to Law No. 23
• Decision No. 95 – 1993	Prohibition on use of monofilament nets and No. 11 hooks for fishing
• Decision 97 -1993	Prohibition on trawling in some areas during July and August spawning period for certain species
• Decision 98 - 1993	Authorizes MWS staff in the municipalities and regions and Libyan trawler captains and their assistants working with National Fishing & Marketing Company NAFIMCO to act as legal officers
• Act number 453 / 1993	Issued by the General People’s Committee of Agriculture and Animal Wealth to prohibit the

	hunting of terrestrial and sea turtles.
<ul style="list-style-type: none"> <li>Act number 326 / 1998</li> </ul>	Related to the transfer of the responsibility and supervision of protected areas to the municipalities' councils
<ul style="list-style-type: none"> <li>Act number 205 / 2001</li> </ul>	Issued by General People's Committee regarding the establishment of Animal Wealth General Authority and one of its tasks to take care of the protectorates and national parks.

## 2. Issues that prevented the implementation of legislations:

Although there are many laws and legislations aimed to protect the biodiversity and natural habitats, their actual implementation has been hindered. These laws need to be implemented and enhanced (Etayeb *et al.*, 2012). The difficulties to take such steps are due to the following reasons:

1. Lack of coordination between different organizations and institutions to implement these legislations plus the overlapping of their tasks.
2. Instability in the administrative bodies and institutions.
3. Lack of public environmental awareness.
4. Lack of specific bodies and agencies to implement these legislations, as well as Lack of capacity building and training in the field of environment protection.
5. The current legislations do not address the new problems of biodiversity and Biosafety; they are outdated and need to be updated.

## II. Institutional framework

### 1. Government institutions

Many Libyan governmental institutions related to Biodiversity have focused on scientific advisory and implementation. Currently, some of them are part of the Ministry of Higher Education and the others are affiliated with the Ministry of Agriculture, Animal and Marine Wealth. All of these institutions (Annex I) have some cooperation and points of contact with local and international organizations.

## 2. Non-Governmental Organization

These organizations are newly established in Libya, mostly comprising qualified scientific experts, interested mainly in maintaining biodiversity and the environment, these NGOs (Annex I) which operate independently are affiliated directly to the Ministry of civil society. They have carried out scientific studies related to biodiversity and environmental science, some of them get financial support from international organizations such as the Libyan Society for Birds and the Libyan Wildlife Trust; some of the Non-Governmental Organizations active in Libya.

## 3. Regional and International Conventions

Libya has signed several international and regional conventions, programmes, agreements and joined several organizations related to marine biodiversity and environment protection; the extent to which international agreements are adopted and practiced through national legislation varies considerably (Table 2).

Table 2. Conventions and programmes relevant to Libya

### **Fisheries**

- Documents related to the 1984 FAO world conference on fisheries management and development, the 1992 FAO Technical consultation on High Sea Fishing and the UN conference on Straddling Fish Stocks and Highly Migratory Fish stocks and FAO council on Fisheries Technical committee of the Council on the Code of Conduct for Responsible Fisheries
- General Fisheries Council for the Mediterranean (GFCM, Rome, 1994 – agreement entered into force 1952
- International Commission for the Conservation of Atlantic Tunas (ICCAT)
- Mediterranean Regional Aquaculture Project (MEDRAP phase I & II) and follow – on network system comprised of SIPAM (Information System), TECAM (Technology), SELAM (Soci-economic and Legal Aspects), and EAM (Environment)
- Coordination to Support Fisheries Management in the Western and Central Mediterranean (CopeMed).

- MedSudMed "Assessment and Monitoring of the Fishery Resources and the Ecosystems in the Straits of Sicily"

#### **Maritime – Fishing safety**

- International Convention for the Safety of Life at Sea (SOLAS)
- Torremolinos International Convention for the Safety of Fishing Vessels (1973) and Torremolinos Protocol (1993)
- FAO – ILO – IMO code of safety for Fishermen and Fishing Vessels (Parts A & B)
- FAO – ILO – IMO Guidelines for the Design, Construction and Equipment of Small Fishing Vessels

#### **UNCLOS**

- United Nations Convention on the law of the sea (UNCLOS, 1982 – entered into force 16.11.94 for all status which have deposited instruments of ratification or accession)

#### **Marine – Coastal Environment & Sustainable Development – General**

- MARPOL 73 -78 (International convention for the prevention of pollution from ships 1973 and protocol amendment)
- Vienna convention for the protection of the Ozone Layer (Vienna 1987) and Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal 1987)
- United Nations Conference on Environment and Development (UNCED) Rio de Janeiro 1992 including convention on Biological Diversity and Agenda 21)

#### **Marine – Coastal Environment & Sustainable Development – Mediterranean**

- UNEP Regional Seas Programme – Mediterranean Action plan (MAP, 1975 – phase II 1995)
- Med Agenda 21
- Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Amended title of the Convention for the Protection of the Mediterranean Sea against Pollution, Barcelona 1976, including related protocols with recent amendments under the Barcelona system, new texts adopted by an intergovernmental conference in June 1995 in Barcelona)
- Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from ships and Aircraft
- Protocol concerning Co-operation in Combating Pollution of the Mediterranean Sea by

#### Oil and Other Harmful Substances in Cases of Emergency

- Protocol for the protection of the Mediterranean Sea against Pollution from Land – based Sources (Athens 1980)
- Protocol Concerning Mediterranean Specially Protected Areas and Biological Diversity (New title text for the Protocol Concerning Mediterranean Specially Areas – Geneva 1982)
- Protocol for the protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation of the continental Shelf and the Seabird and its Subsoil (Madrid 1994)
- Protocol for the Prevention of Pollution of the Mediterranean Sea resulting from the Trans boundary Movements of Hazardous Wastes and Their Disposal (expected to be adopted within the Barcelona framework in 1996)
- International Centre for coastal and Ocean Policy Studies (ICCOPS – NGO est. Genoa, Italy)
- Agreement on the Conservation of African – Eurasian Migratory Water birds (AEWA),, is an agreement under the Convention on the Conservation of Migratory Species of Wild Animals (CMS),
- The Ramsar is an intergovernmental treaty which provides the framework for national action and international cooperation for conservation and wise use of wetlands and their resources, it was adopted in 1971, and came into force 1975
- Agreement on the Conservation of Cetaceans in the Mediterranean, Black sea and Adjacent Atlantic Area (ACCOBAMS).

#### **Bilateral agreements**

- Delimitation of the continental shelf between Libya and Malta (10-11-86)
- Delimitation of the continental shelf between Libya and Tunisia (08-08-88)

### **III. Scientific aspects**

#### **1. Overview of the marine biodiversity in Libyan coast**

##### **1.1. General description of the Libyan coast**

Libya has a long coast that extends to 2000 km. It is divided into three main regions according to the topography of the continental shelf, which is wide in the western part and becomes less wide in the gulf of Sirte and narrows in the eastern part.

The habitat in the eastern part constitute mostly of a rocky coast, including rocky shores, sandy seabed's, shallow and deep-water (200 m+) with a considerable number of bays, and submerged caves and partially-submerged sea caves, which supports a range of benthic biota, marl beds and a range of marine communities These areas have become well colonised by a variety of sessile and mobile species including Mediterranean protected species such as marine mammals and the hammerhead shark. This region has several wetlands namely Ain Al-Ghazala which is also a designated MPA, Ain AL-Zeana, Ain Al-Zargha and Ain Alshagegh. Some are connected by running fresh water from nearby springs in different area as in Wadi Al Hamsa, Al Khalij and Al Burdi, these areas have become well known sites for many endangered species like sea turtles and birds, although the presence of sandy beach's is limited, there are considered important for Marine turtles and Ghost crab. In general, the danger that threatens this region and destroys the marine habitat is the use of dynamite for fishing, the collection of sand from the sandy beaches and birds hunting.

The middle region (Sirte Gulf), is mostly sandy beaches interspersed with small rocky areas, it provides suitable habitat for fish species, thereby supporting a wider marine food web, which includes larger pelagic fish species (e.g. Bluefin Tuna and sharks), seabirds, marine mammals and reptiles. It is considered important habitat for different endangered elasmobranches species and sea turtles. The beach connected to sea through salt marches including Sultan Sabgha which measures 11 km long. This region including the protected areas like Alhesha site and Taugh site. This area is mostly threatened by the ballast water because most of the oil terminals and harbours are located in this area. Also, the overfishing of sharks as well as the disturbance of sea turtles and sea birds add other burdens. The western region is characterized by a wide continental shelf and it extends from the Gulf of Gabes in Tunis to the Gulf of Sirte, making this area the best fishing region in the Mediterranean. Most of the coast is rocky, interspersed with some

sandy areas and the presence of Farwa Island, which has become a Marine Protected Area and is characterized by the existence of many endangered species (Etayeb *et al.*, 2012). The most threatening human activity in this area is industrial pollution from the Abokhamesh complex and Mellita oil terminal for Petrochemicals.

## 1.2. Previous studies

Despite the length of the Libyan coast and its diversity in habitats, versus the number of threats, there are several studies carried out along this coast. Table 3 presents some important studies conducted in this area.

**Table 3. Monitoring studies in the Libyan coast**

Name	Date	Description
<ul style="list-style-type: none"> <li>Study of marine plankton Tripoli area (Tajura)</li> </ul>	2006	Study the diversity of marine plankton to identify the species of zooplankton and phytoplankton and determine its presence variation during the year water Tajura coast
<ul style="list-style-type: none"> <li>Study of marine plankton Tripoli area (Gergarash)</li> </ul>	2006	The study to identify the groups and species of zooplankton and phytoplankton, identify and classify them during the seasons
<ul style="list-style-type: none"> <li>Diagnosis and review the mortality of <i>Epinephelus marginatus</i> in eastern coast of Libya</li> </ul>	2008	The disease is encephalopathy and retinopathy (VER), or what is known as Viral Nervous Necrosis (VNN), which is caused by a species of RNA virus family (Nodaviridae) of the genus Betanodavirus.
<ul style="list-style-type: none"> <li>Study of bacterial pollution caused by sewage water into the sea in the cities of Misurata and Al- Ghoms</li> </ul>	2007	Study of bacterial pollution caused by the sewage water level untreated into the sea in the cities of Misurata and Al-Ghoms, which can be used as a database for the interpretation of some

		environmental phenomena that may occur in the future
<ul style="list-style-type: none"> <li>• Microbiological study of the effects of the sewage water on the coastal area of Tripoli</li> </ul>	2008	Study the effect of sewage water into the coastal water of Tripoli, order to know the impact on the ecosystems and health
<ul style="list-style-type: none"> <li>• Pollution by hydrocarbons</li> </ul>	1981	The spread of petroleum hydrocarbons dissolved on the Libyan coast
<ul style="list-style-type: none"> <li>• Pollution by oil</li> </ul>	1993	Study the melting and the spread of oil in the western coasts of Libya
<ul style="list-style-type: none"> <li>• Heavy metal mercury in mollusks</li> </ul>	1994	The concentration of heavy metal (mercury) in mollusks (Cephalopods) caught from the Libyan coast.
<ul style="list-style-type: none"> <li>• Industrial pollution in the western region</li> </ul>	2001	Study of industrial wastewater impact on the marine environment corresponding to the compound of Abo-Kemash for chemical Industries
<ul style="list-style-type: none"> <li>• Chemical and physical characteristics study</li> </ul>	2001	Study of the chemical and physical characteristics of Al-Bompa Bay in the eastern region of the Libyan coast
<ul style="list-style-type: none"> <li>• Heavy metal in the western Libyan coast</li> </ul>	2005	Study of the concentration of petroleum hydrocarbons in <i>Patella coerulea</i> of (Gastropoda) in the western coast of Libya
<ul style="list-style-type: none"> <li>• Oil pollution in the eastern region</li> </ul>	2005	Study of oil pollution to some lakes in the eastern region of Libya
<ul style="list-style-type: none"> <li>• Impact of sewage water in the eastern region</li> </ul>	2007	Study of the chemical and physical effects of sewage water on the coast of Qaminis to Deriana Benghazi region
<ul style="list-style-type: none"> <li>• Environmental study of Farwa Lagoon</li> </ul>	1990	Environmental study of Farwa Lagoon: sectorial distribution and histological analysis of

		sediment particles sizes and estimating organic matter, bacteria, organic nutrition bottom sediments
<ul style="list-style-type: none"> <li>• Environmental study of salt marshes (Abokamash)</li> </ul>	2005	Study the reproduction characteristics and life cycle Artemia characteristics and identify some species of algae in Abokamash salt marshes
<ul style="list-style-type: none"> <li>• Scientific field survey report for the development of Marine Protected Areas in Libya</li> </ul>	2010	This survey has gathered key biological and socioeconomic information of the area comprising Ain El Ghazala and the Gulf of Bomba
<ul style="list-style-type: none"> <li>• Monitoring Mediterranean Lesser Crested Terns <i>Thalasseus bengalensis emigratus</i>.</li> </ul>	2012	This study has provided a tool which will allow a coherent and safe approach to a population of extremely high conservation value, which is potentially vulnerable to many sources of threat
<ul style="list-style-type: none"> <li>• Economic and social survey of El Kouf National Park in Libya</li> </ul>	2015	This survey has conducted on the socio - economic assessment of both marine and coastal areas of El Kouf National Park

## 2. Threats adversely affecting marine biodiversity

In recent years, human activities impacting marine habitats and biodiversity along the Libyan coast have increased dramatically. The use of forbidden fishing methods; i.e. 70% of landing sites using dynamite for fishing, has drastically damaged the aquatic marine habitat (Shakman *et al.* 2014). Other threats adversely affecting marine biodiversity include:

- Coastal development and unattended coastal tourism
- Fishing in critical ecosystems
- Invasive species
- Trading of threatened species

- Overfishing
- Discharge of sewage water
- Discharge of construction debris
- Collecting sand from sandy beaches
- Illegal fishing and Illegal fishing gears.
- Discharge of ballast water and seawater desalination facility.

### 3. Protected areas

Only two areas have been selected to be Marine Protected Areas in Libya (MPAs), which are managed by the Ministry of Agriculture, Animal and Marine Wealth; they are Ain Al-Ghazalla and Farwa lagoon several studies have been carried out in these areas by national institutions and international organization. (Fig. 1).

- **Ain Al-Ghazalla**

A narrow inlet of the sea in a limestone coastal plain (probably a drowned river mouth) adjoining Ain Al Ghazala town, with inflow of fresh water from springs. Shores with sparse *Suaeda* vegetation. At the southern end, a narrow belt of reeds is present and behind it a considerably large, but overgrazed, salt pastures extend to the main road. Mixture of fresh and saline water encourages productivity, and fish populations are rich. There are also some local fishing and aquaculture (cages in water) activities taking place inside the lagoon. The large Seagrass meadows at Ain Al Ghazala lagoon are reported as an indicator of low degree of pollution (Reynolds *et al.*, 1995). Salinity levels are close to that of seawater and there is a high level of dissolved oxygen. The lagoon of Ain Al Ghazala hosts a breeding site of the loggerhead sea turtle *Caretta caretta*. Mating occurs inside the lagoon (Pergent *et al.*, 2007) while the eggs' deposition takes place outside along the sandy coastal region located to the east (Laurent *et al.*, 1999). Forty-one fish taxa and 2 molluscs have been recorded, from a study on commercial fisheries and fish species composition in the eastern coastal waters of Libya (Shakman and Kinzelbach, 2007).

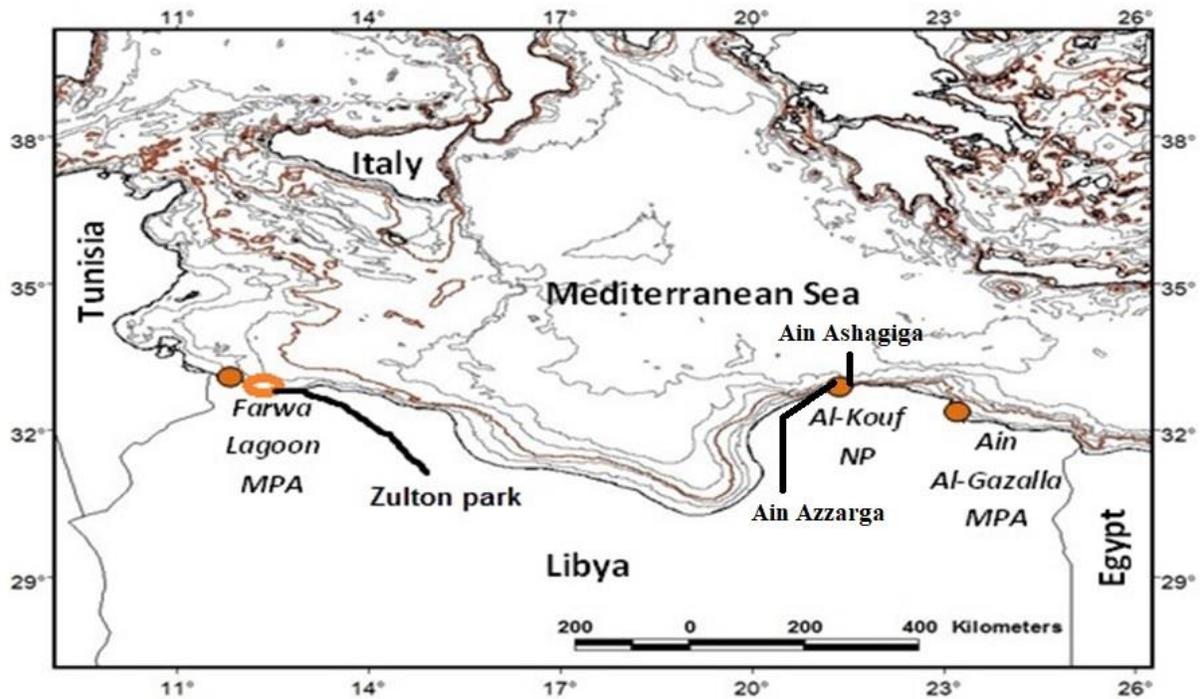


Fig. 1. General Libyan map shows the areas conservation (MPAs, NPs and Ramsar sites), and general bathymetry of the area

- **Farwa lagoon and Island**

The island is about 11 Km in length with maximum width of about 0.5 km, and the total area is about 5.5 sq. km., the island is connected to the sea from the west with an opening of 10 m wide (Per. Observ.). The area is composed of sandy to clayey loam in southern region towards the mainland, sandy in the eastern region while the western region is dominated by marshes; water puddles and elevated *Posidonia oceanica* crust near the sea. The quite vast lagoon which is rather a deep bay, its maximum depth varies between 0.5 - 2.5 m. The lagoon is surrounded by many Sebkhahs which extend east up to the town of Zuwarah and include the protected Park of Zulton (Fig. 1). Some of these supratidal sebkhahs are vegetated with *Arthrocnemum* sp. flooded in winter and have occasional water exchanges with Farwa lagoon. Furthermore, the lagoon bottoms are almost occupied by three vegetal assemblages.

Farwa is located at the furthestmost western part of Libya; it has unique diverse habitats of extensive tidal areas, mudflats and accumulations of *Posidonia oceanica* on the northern part of the island. These conditions provide good nesting grounds for some species of birds such as *Sternula albifrons*, *Sterna hirundo* and *Charadrius alexandrinus*. Moreover; the area attracts

many migratory bird species in large numbers of individuals during their journey to Africa or to spend the winter season in Libya (Etayeb, 2002). Four endangered bird species were reported at the area, as well as one of the endangered species in the Mediterranean region Loggerheaded sea turtle *Caretta caretta* that uses the Island's sandy beach for nesting. Over all, a high priority for protection measures is necessary to maintain the current character and components of the area (Etayeb *et al.*, 2012).

#### **4. Ramsar sites**

The Convention was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975. Since then, almost 90% of UN member states, from all the world's geographic regions have joined the convention has entered into force in Libya on 5 August 2000. Now Libya has two sites designated as Wetlands of International Importance (Ramsar Sites) (Fig. 1):

- **Ain Ashagiga**

A coastal lagoon, covering a few hundred hectares (RIS says 33 hectares, which seems far too small), very close to Sebkheth Ain Azzarga. Fed partly by incursions of sea water through channels connecting the site to the sea, but also by springs from nearby mountains, probably of karstic origin (Azfzaf *et al.*, 2005)., situated in the coastal plain, below the limestone plateau of the Jebel Akhdar, and unusual in being surrounded not only by sand dunes but also by limestone formations, covered by well-preserved typical vegetation. Retains humidity in the summer, but salinity increases. Vegetation on the inland side included an extensive *Tamarix* woods growing on flooded soil, and relatively large *Juncus* stands. RIS indicates similar vegetation, amphibians and molluscs to Ain Azzarga (Azafzaf *et al.*, 2005).

- **Ain Azzarga**

Coastal lagoon, covering a few hundred hectares (Ramsar Information Sheet - RIS - says 50 hectares, which again seems too small), fed partly by incursion of sea water through substrate channels connecting the site to the sea, but also by springs probably of karstic origin. Situated in the coastal plain below the limestone plateau of the Jebel Akhdar, and unusual in being surrounded not by sand dunes but by limestone formations (Azafzaf *et al.*, 2005). It retains humidity all year round, but salinity increases in summer, vegetation on the inland side included extensive fringes of *Tamarix*, with more freshwater-loving plants such as *Juncus*. The RIS also mentions *Phragmites* and *Ruppia*, and notes the presence of the amphibians *Rana saharica* and

*Bufo viridis*, together with endemic fish and the following molluscs: *Hydrobia acuta*, *Ventrosia ventrosa*, *Cerastoderma jonica*, *Spondyllus spectrum* and *Cerastoderma glaucum* (Azafzaf *et al.*, 2005).

## **5. Biodiversity-Marine habitats**

According to the topography of the continental shelf, the Libyan coast has been divided into three main regions. The habitat in the eastern part constitute mostly of a rocky coast, including rocky shores, sandy seabed's, shallow and deep-water with number of bays, and submerged caves and partially-submerged sea caves. The middle region is mostly sandy and interspersed with small rocky areas. Finally, the western region is characterized by a wide continental shelf. Most of the coast is rocky, interspersed with some sandy areas and sand bars.

## **6. Biodiversity-Marine mammals**

In Libya, literature regarding marine mammals (and marine biota in general) is very scarce and limited despite the relatively long coastline the country possesses (IUCN 2011, IOC 2003). Referring to cetaceans, published information is limited to two papers alone, Bearzi, 2008 and Boisseau *et al.* 2010. Based on an interview survey with local researchers and fishermen, Bearzi (2006) reported that dolphins (mainly bottlenose) are abundant and maybe increasing in numbers (according to the fishermen statements) within the Libyan waters, and even though there are some cases of predation and damage of the fishing gear, the fisherman tend to 'accept' this and consider dolphins to be 'special animals' that should be respected and not harmed. Bearzi 2006 suggested that the increase in dolphin abundance might be related to the reduction of other top predator ichthyofauna species such as groupers (*Epinephelus sp*), amber jack (*Seriola dumerili*) and tuna (*Thunnus sp*) which is highly demanded by the local market. The species of cetaceans that are occurring or are expected to be present in Libya include: the bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphus*), striped dolphin (*Stenilla colarualba*), Risso's dolphin (*Grampus griseus*), Cuvier's beaked whale (*Ziphius cavirostris*), sperm whale (*Physeter macrocephalus*) and fin whale (*Balaenoptera physalus*). During their Mediterranean Basin Survey conducted between 2003 to 2007, Boisseau *et al.*, 2010 managed to encounter few of the species mentioned by Bearzi 2006 confirming their presence in Libya. The survey also made one observation of the rare rough-toothed dolphins (*Steno bredanensis*) offshore Cyrenaica (northeast Libya). Along with these two publications, there are other reports and sources that contain some information about cetaceans' distribution, for instance the

Mediterranean Database on Cetaceans Stranding ([www.medaces.uv.es](http://www.medaces.uv.es)), and data extracted from few accessible seismic surveys reports. These sources indicate only information about the species presence, as for the other parameters such as abundance; distribution and interaction with anthropogenic activities, there are no information or monitoring activities related to them in Libya. As for other marine mammals' species, and specifically the critically endangered monk seal (*Monachus monachus*), there are historic information that suggest the presence of small breeding colonies in Cyrenaica during the 1970s (Norris 1972). Since then, the status of this species in Libya was always unclear until 2011 when a female monk seal was by-caught in a local fishing net within Ain Al-Gazalah MPA proximity (Alfaghi *et al*, 2013).

### **6.1. Suitability of habitats for marine mammal species in Libya (sub-regions) and the anthropogenic impacts in each area**

The marine environment associated with Libyan coastline varies considerably and can be divided according to depth, slope, habitat and topography as demonstrated by (IUCN 2011). Within these sub-regions, there are certain areas that are/could be suitable habitats for marine mammals based on the fragmented data available, such as Cyrenaica offshore

#### **6.1.1. Farwa lagoon and adjacent area (33.098<sup>0</sup>N, 11.694<sup>0</sup>E):**

This area was designated as an MPA by EGA-Libya in 2009. The lagoon consists of a shallow plateau (part of the Tunisian Plateau) covered with seagrass species of *Cymodocea nodosa* and *Posidonia oceanica* which increase productivity and biodiversity in the region (Defos *et al.* 2001, Coll *et. al* 2010). In turn, top predators (such as cetaceans, sharks and birds) are known to be attracted to high-biodiversity areas (Carpenter and Kitchell 1993, Steneck and Sala 2005). Hence this area should be marked as important to cetaceans. To support that, there are several records of sightings for bottlenose dolphins and common dolphins in the region. There are also, few stranding events in this area including; fin whales, bottlenose and common dolphins (Haddoth person. comm.). The lagoon is under extensive pressure by different anthropogenic activities including fisheries, pollution and urbanizing the coastline. Large number of fishing vessels coming from the nearby harbor of Zwara (32.929<sup>0</sup>N, 12.089<sup>0</sup>E) operates in the gulf vicinity (Lamboeuf and Reynolds, 1994; Lamboeuf *et al.*, 1995). Issues such as predation on the catch (by the dolphins), prey species depletion, entanglement and bycatch in fishing gear should be further investigated. Pollution is also known to occur in the lagoon from the urban areas, the petrochemical complex in Abukammash and the desalination station in Zwara (IUCN, 2011).

### **6.1.2. The Cyrenaican coast (32.608<sup>0</sup>N, 21.864<sup>0</sup>E):**

A large peninsula formation in north eastern Libya, this area already contains a National Park (Al-Kouf), and an MPA at its eastern borders (Ain Al-Gazalah). This area was described by WWF as one of the last 10 marine paradises in the Mediterranean (WWF Gap Analysis 1998, WWF/EGA/NBRC, 2004). There were few surveys conducted in that area that would nominate these areas as important to marine mammals (see chapter 3). Also, the marine geomorphology of this area presents certain formation which should be suitable habitat to different cetacean species. The steep continental shelf (less than 5km in some areas), and the presence of deep-sea canyons leading to the Herodotus Trench offshore (33.296<sup>0</sup>N, 22.608<sup>0</sup>E), all present suitable habitats for deep diving species such as Cuvier's beaked whale and sperm whales (IOC, IHO, and BODC, 2003; Würtz 2012; Tepsich *et. Al.*, 2014).

Threats to marine mammals in this area seemed minimum and mainly related to the marine ecosystem itself. The use of destructive fishing methods such as dynamite, and the presence of few pollution hotspots from coastal cities are the main concerns over marine mammals' conservation in Cyrenaica.

### **6.1.3. The Gulf of Bombah and the adjacent area (32.341<sup>0</sup>N, 23.120<sup>0</sup>E):**

Encompassing Ain Gazalah MPA, the gulf is biodiversity hotspots due to the large seagrass meadow (*Posidonia oceanica* and *Cymodocea nodosa*) and the import of fresh water from Ain Gazalla lagoon (Badalamenti *et. al.* 2011; Godeh *et al.*, 1992). Along with previous sightings of monk seals (Norris 1972), bottlenose, common and striped dolphins, there are also few stranding events of fin whales in the gulf area (Benamer. Not published). Anthropogenic activities that could have impact on marine mammals include fisheries and pollution hotspots (e.g. Tobruk city and harbor less than 30km to the east).

## **6.2. Long term monitoring schemes**

At the moment, there are no operating monitoring programmes for marine mammals in Libya. During the period from 2002 to 2007, a monitoring programme was launched under an MoU between UNEP, SPA/RAC, EGA-Libya and Istituto Centrale per la Ricerca Applicata al Mare (ICRAM, Italy), to assess the status of the monk seal population in Libya. The first stage was in the form of an interview based-approach with the local fishing communities in Cyrenaica and resulted that the species might still have presence in that area (Hamza *et al.*, 2003). The second stage involved identifying possible resting caves for that species and installing camera traps

within these caves. However, the survey was incomplete and faced several logistic and technical issues which hindered its progress. Regarding cetaceans, there were few attempts to establish monitoring programmes in Libya and these were of small scale and opportunistic nature. The trail of establishing a stranding network during 2007 - 2009 in eastern Libya is one of them. This was arranged mainly by the local Omar Mukhtar University in collaboration with the Environmental General Authority of Libya. In this attempt, a reward based-approach was adapted to encourage the local fishing community to report stranding events. There was also the short-termed mark-recapture survey that was conducted in Cyrenaica targeting the local bottlenose dolphin population during 2013 and 2014. Again, this survey was postponed for logistic and safety reasons (Benamer not published).

## 7. Biodiversity-Sea birds

First information published regarding birds in Libya was early in the previous century by Zavattari, 1934, another two overviews have been published (Bundy, 1976). More publications appeared after this period about waterbirds (Gaskell, 2005; Smart *et al.*, 2006; Hering, 2009). However, even with these publications Libya remains one of least studied countries in the Mediterranean. In midwinter 2005, the waterbirds survey established for the first time and was organized by the Environment General Authority with the support of AEWA and SPA/RAC. This survey became a regular event and some preliminary results were published (Azafzaf *et al.*, 2005; Smart *et al.*, 2006). After six years of studies and collecting data, the Atlas of wintering waterbirds of Libya 2005-2010 was published, since that several papers have been published (Etayeb *et al.*, 2007, 2015; Bourass *et al.*, 2013). Finally, a book about Libyan birds which covered all knowledge gaps regarding birds in Libya was published in 2016 (Isenmann *et al.*, 2016). Table 4 illustrates the monitoring programme that has been done along the Libyan coast.

**Table 4. Monitoring programme for waterbirds in the Libyan coast**

Monitoring programme	Description of the monitoring programme	Implementing agency
<ul style="list-style-type: none"> <li>Action plan to address bird trapping along the</li> </ul>	It is an action plan to manage and reduce trapping and illegal killing in Libya and	EGA and LSB

Mediterranean coasts of Egypt and Libya	Egypt	
<ul style="list-style-type: none"> <li>Monitoring of waterbirds during breeding</li> </ul>	It is an activity for monitoring waterbirds during breeding season in some potential breeding sites.	LSB
<ul style="list-style-type: none"> <li>Ringling programme for Mediterranean Lesser Crested Terns <i>Thalasseus bengalensis emigrates</i></li> </ul>	Ringling to collect the information about the population during migration, as well as to follow the three different colonies in Libya	EGA

### 8. Biodiversity – Sea turtles

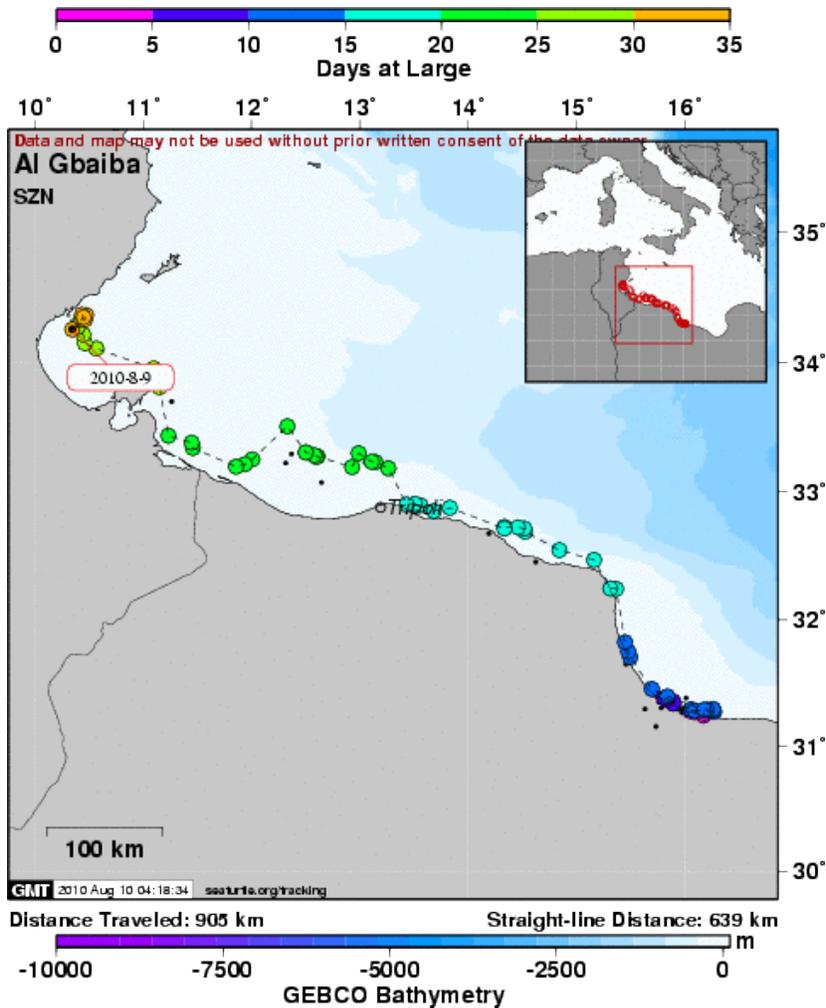
The three species of sea turtles reported from Libyan waters are: the green turtle *Chelonia mydas*, the leatherback turtle *Dermochelys coriacea*, which is irregular and rarely observed at sea, and the loggerhead turtle *Caretta caretta*, which is the only reported nesting species in the Libyan coast (Schleich, 1987; Laurent *et al.*, 1997; 1999). Nesting activity has been reported in the literature since the 1980s (Armsby, 1980). The scientific studies specific to these species began in the mid-90s with national surveys of nesting sites. These prospections have addressed the importance of nesting sites with nesting populations exceeding those of Turkey, Cyprus and would be equivalent or even larger than those of Greece (Laurent *et al.*, 1997 and 1999). Table 5 shows some monitoring programmes that have carried out along the Libyan coast.

**Table 5. Monitoring programme for sea turtle along the Libyan coast**

Monitoring programme	Description	Implementing agency
Libyan Sea Turtles Conservation Programme	Since 2005, the Libyan Sea Turtle Programme (LibSTP) was launched by the Environment General Authority in Libya (EGA) to monitor most of the important nesting beaches to protect beaches, nesting females and hatchlings and to determine eco-biological parameters necessary for any conservation activity (importance of nests, density of nests and hatching and	EGA

	emergence rates.	
Sea Turtles Tagging	<p>Tagging of loggerheads in Libya started in the mid-1990s, when blue plastic flipper tags (rototags) were fixed with the SPA/ RAC return addresses, were placed on eight nesting loggerhead turtles during surveys in 1996 (Haddoud &amp; El Ghmati 1996). To date, none of these plastic tags have been reported as recovered after initial deployment.</p> <p>Plastic tags may increase likelihood of entanglement of turtles in nets. They are also easily fouled or worn down, making them illegible, the Libyan Sea Turtle Program decided to tag with metal Inconel tags, which are the most commonly recommended flipper tag. During the 2008 to 2010 nesting seasons we patrolled up to four nesting beaches either by foot or by 4x4 vehicles.</p>	EGA
Satellite Tracking	<p>Two missions were organised in 2009 and 2010 in collaboration between the Environment General Authority of Libya (EGA), the Stazione Zoologica of Napoli (SZN) and SPA/ RAC. in the periods from 19 – 25 July 2009 and 5 – 11 July 2010. The field work was carried out during the nesting monitoring activities of the Libyan Sea Turtle Program (LibSTP) in the west Sirte region. During the first mission in 2009 three female loggerhead turtles were equipped with satellite transmitters, one in Misurata (32.383°N, 15.056°E) and two in Sirte (31.206°N, 16.588°E). In 2010 two further turtles that nested</p>	EGA

	in Sirte were equipped (Fig. 2).	
Sex-ratio estimations of loggerhead sea turtle hatchlings	Recalling the articles of the SPA protocol and the revised action plan on marine turtles in the Mediterranean, taking into account the new developments concerning conservation measures based on scientific groundwork, and considering the potential effects of global warming on future population structure and on the dynamics of these endangered species (Hawkes et al. 2009, Witt et al. 2010), the present study aimed to provide data on hatchling sex ratio estimation from five nesting beaches west of Sirte, which are among the most important nesting grounds for loggerhead turtles in Libya and potentially in the Mediterranean (Hamza, 2010)	EGA



**Fig. 2.** Map shows the tracking marine turtles in the western coast of Libya

### 9. Non-indigenous species

In general, Non-indigenous species pose a threat to biodiversity by impacting: native species ecosystems either directly (affecting hydrology, nutrient cycling, and other processes, mainly by the so-called ‘ecosystem engineers’), or indirectly by changing the whole ecosystem structure and functioning (introduced species often consume or prey on native ones, overgrow them, compete with them, attack them, or hybridize with them). The study of these impacts need a continued research programme on the issue (monitoring Non-indigenous species and their impact for an integrated ecosystem-based management approach over the entire area), table 6 shows some studies that have been carried out along the Libyan coast. In general, 70 Non-indigenous species have been recorded and some of them have distributed along the coast, and a number of these species have become commercial and regular in the Libyan markets (Shakman *et al.* in

prepare). Also, several studies have been carried out on the impact and biological aspects of these species. Table 6 shows a number of these studies.

**Table 6. Studies on non-indigenous species along the Libyan coast**

Name of study	Description	Reference
Monitoring the invasive fish species along the Libyan coast	Collection and classification of Invasive fish species along the Libyan coast, where several invasive fish and recorded was documented	Ben abdalaha <i>et al.</i> , 2005
Lessepsian Migrant Fish Species of the Coastal Waters of Libya: Status, Biology, Ecology	This study presented a monographic research on the present status of immigrant fish species in Libyan coastal waters, focusing on Lessepsian migrants.	Shakman, 2008
Distribution and characterization of lessepsian fish species	A total of sixteen Lessepsian fish species were found (Table 2). Four of them are recorded for the first time on the Libyan coast their morphological and meristic characters are described	Shakman and Kinzelbach, 2007a
Commercial fishery and fish species composition in coastal waters of Libya	The number of boats found in this study was 1,511; of them 64.3% were “flouka”, 24.1% were “mator”, 6.9% were “lampara” and 4.8% were “batah”, the highest fish species diversity in the coastal area was in the eastern region (45.65%) while in the gulf of Sirte and western regions were 23.91% and 30.43% respectively	Shakman and Kinzelbach, 2007b
Reproduction and spawning season of <i>Siganus luridus</i> and <i>S. rivulatus</i>	Some biological aspects Such as reproduction and spawning season for both <i>Siganus</i> spp. have been studied along the Libyan coast	Shakman 2008
Food and feeding habits of the Lessepsian migrants <i>Siganus</i>	<i>Siganus luridus</i> showed a stronger affinity for brown algae while <i>S. rivulatus</i> targets a	Shakman <i>et al.</i> , 2009

<i>luridus</i> and <i>Siganus rivulatus</i> (Teleostei: Siganidae) in the southern Mediterranean (Libyan coast)	broader range of food items, with Rhodophyta and Chlorophyta algae playing a pronounced role in its diet. The diet overlap between both species was high. Both species seem to be well established in the southcentral Mediterranean.	
Morphometry, age and growth of <i>Siganus luridus</i> and <i>Siganus rivulatus</i> (Siganidae) in the central Mediterranean (Libyan coast)	Some biological aspects of two siganid fish species from the Libyan coast were studied in terms of morphometry, age and growth. Samples of two species were collected, between March 2005 and March 2006, comprising of 1,672 individuals of <i>S. rivulatus</i> from the eastern coastline and 1,756 individuals of <i>S. luridus</i> from the western coast and the Gulf of Sirte	Shakman <i>et al.</i> , 2008
Investigation of gene flow in population of <i>Siganus luridus</i> and <i>Siganus rivulatus</i> in the Mediterranean	Results suggested that in both <i>Siganus</i> spp. Each species belongs to the same gene pool, assuming the migration in the Mediterranean took two pathways, to the north-west and south-west.	Shakman <i>et al.</i> , in press
Alien marine species of Libya: first inventory and new records in El-Kouf National Park (Cyrenaica) and the neighbouring areas	Until now 63 marine aliens species have been recorded along the Libyan coastline. These include 3 Foraminifera, 3 Ochrophyta, 5 Rhodophyta, 5 Chlorophyta, 1 Magnoliophyta, 11 Arthropoda, 13 Mollusca, 1 Echinodermata and 21 Chordata. Among these Non-Indigenous Species, 43 are known as established along the Libyan coast including 8 invasive, 11 casual, 5 questionable, 3 cryptogenic and 1 unknown	Bazairi, <i>et al.</i> , 2013

First records of seven marine organisms of different origins from Libya (Mediterranean Sea)	Seven first records of species of various origins are reported from the Libyan marine environment. These are the Longfin yellowtail <i>Seriola rivoliana</i> , Lesser amberjack <i>Seriola fasciata</i> , Blunthead puffer <i>Sphoeroides pachygaster</i> , Golani round herring <i>Etrumeus golanii</i> , Blue swimmer crab <i>Portunus segnis</i> , Bigfin reef squid <i>Sepioteuthis lessoniana</i> , and the green alga <i>Caulerpa taxifolia</i>	Shakman <i>et al.</i> , 2017
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## 10. Fisheries

Libya has 131 landing sites, more than 91 % of them were permanent and around 8% were seasonal (Fig. 2). Three types of landing sites were observed: harbors (42.86%), protected bays (31.75%) and open beaches (25.4%) (Fig. 3). Seven types of fishing boats were recognized; flouka (70.06%), mator (18.14%), lampara (3.28%), Tarrad (0.41%), Gayag (0.16%), Daghessa (5.97%) and batah (1.98%) (Fig. 4). Most of the fishing vessels concentrated in the western region of the country. Trammel nets are the most common fishing gears about (80%), and are used mainly by flouka, mator, Tarrad and batah. Trammel nets fishing rely on the fishing season, fish size and the target fish species. Other fishing gears (Longline, handline and gill nets) are used occasionally (Shakman *et al.*, 2014).

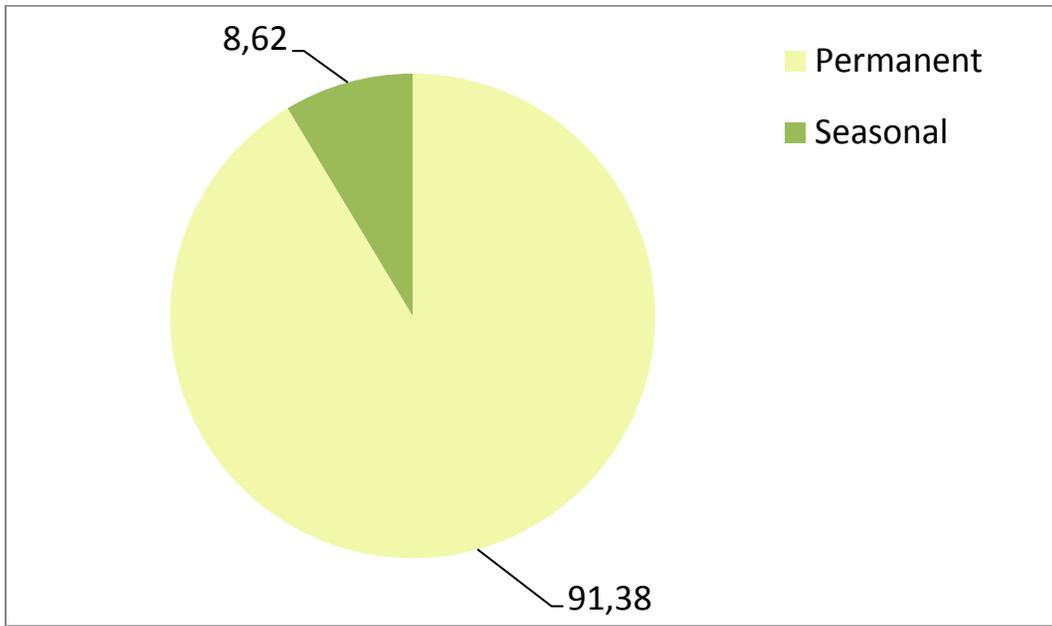


Fig. 2. Landing sites of Libya (Shakman *et al.*, 2014)

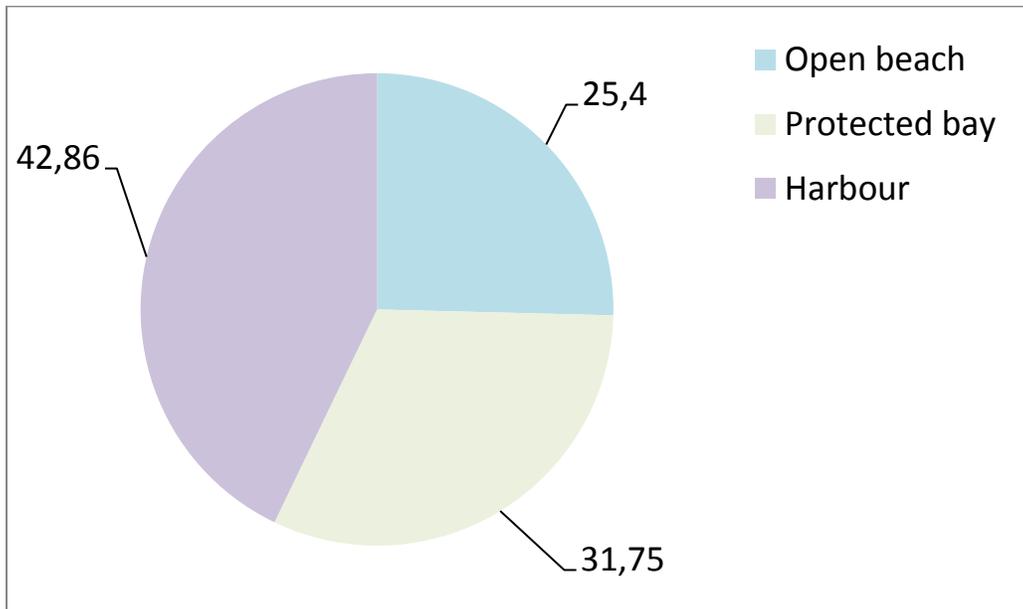


Fig. 3. Type of landing sites along the Libyan coast (Shakman *et al.*, 2014).

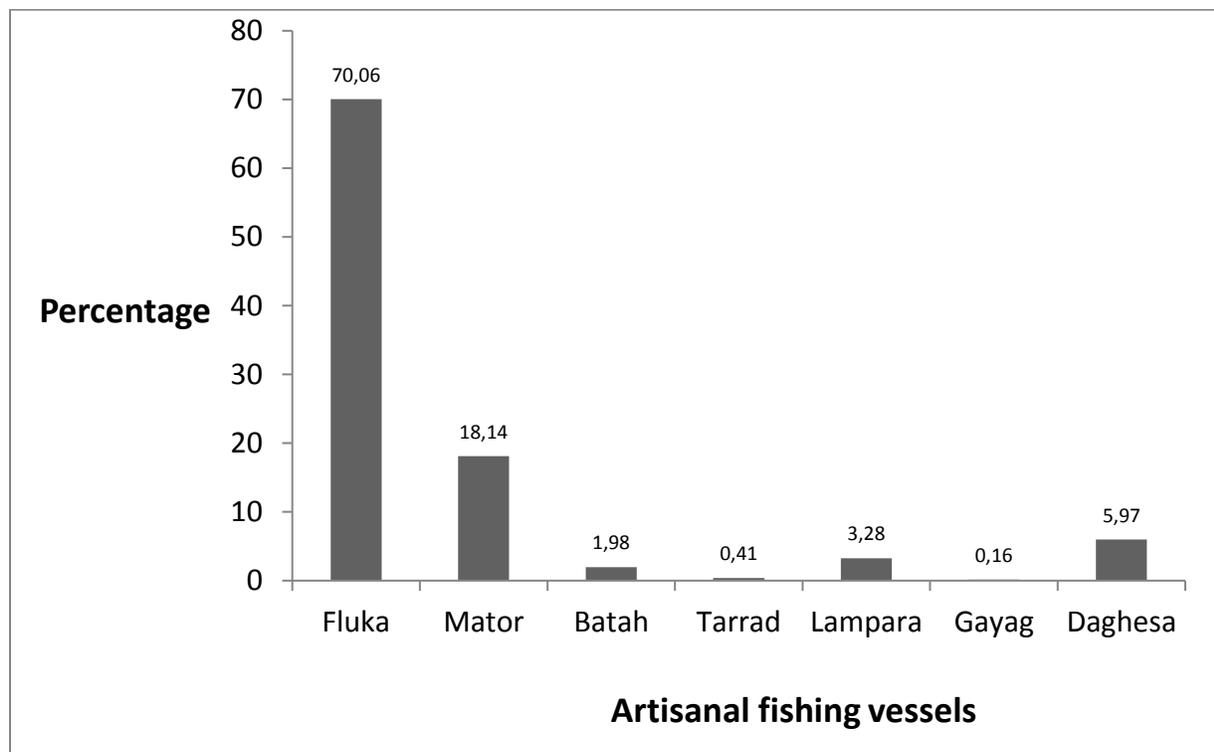


Fig. 4. Artisanal fishing vessels in Libyan coast (Shakman *et al.*, 2014).

#### 10.1. Fish species

Fifty-eight species of chondrichthyans have been found along the Libyan coast belong to twenty-two families (Fig. 5), most of them were distributed in the eastern region, and most of them were occasional. Recently, one male and one female specimens of tiger shark, *Galeocerdo cuvier* were accidentally caught by a drifting longline for swordfish in the south Mediterranean (Libyan coast). This finding confirms beyond any doubt that the tiger shark may be encountered in the waters of the Mediterranean Sea; this study has showed some important information on chondroichthyes in Libyan waters it has provided a contribution to other studies as well as gave some biological information to the researchers and specialists at the local, regional and international levels (Taboni *et al.*, 2015). In 1977, 39 cartilaginous fish species and 185 osteichthyes species were listed in Libya (Contransimex, 1977). From 42 fish species that have caught by trammel net of the coastal area, the highest fish species diversity in the coastal area was in the eastern region (45.65%) while in the Gulf of Sirte and western regions were 23.91% and 30.43% respectively (Shakman, 2008).

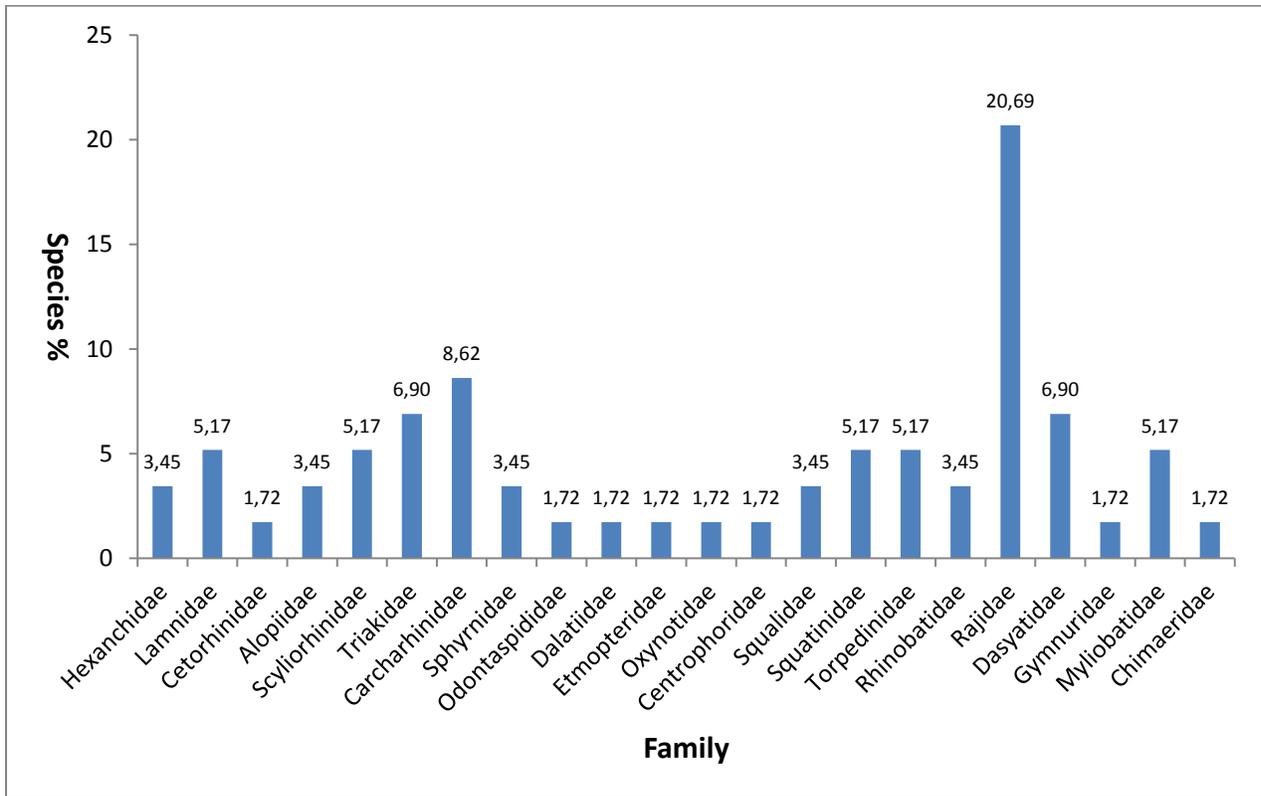


Fig. 5. Chondrichthyan in the Libyan coast (Shakman *et al.*, in press)

## 10.2. Cephalopods

The composition of cephalopods recorded in the Libyan waters contains a total of 24 species representing 8 families in 3 orders, this includes 8 Sepioids, 9 Teuthoids 7 Octopods, *Thysanoteuthis*, *Cephalopoda*, *Decabrachia* were found for the first time in the Libyan coast (Shakman *et al.*, in prepare).

## 10.3. Fisheries monitoring surveys

Many surveys have been done along the Libyan coast using different kinds of vessels started from 1965 and table 7 lists these monitoring surveys:

**Table 7. Fishery monitoring surveys in the Libyan coast**

<b>Name</b>	<b>Date</b>	<b>Area</b>	<b>Description</b>	<b>Reference</b>
Dauphin	1965	Djerba Zliten		Mokadem, 1965
Thalassa	1969	Lampeduzza, Gabes, Azzuitina		ISTPM, 1969
Hoyo –Maru Almuktashef, Hannibal	1972 1974	Malta Gabes Tripoli Sirte Derna		Gorgy <i>et al.</i> , 1972 & Universal Marine Consultant 1975
Al-Baheth				
Hoyu Maru	1972	Tunisia and Libyan coast	Survey of the area located between the Sicilian island to the north, Tunisia and Libya in the south and the Gulf of Sirte and the narrow continental shelf and coast of Tobruk for the purpose of the economic viability of this region during the study period of 18 August and up to 19 September in 1972.	
Researcher and discoverer	1974	West region	Libyan fisheries development program during the period from 14 March until 13 May in 1974, the sea area west of the Libyan coast, the study found that fish finders limited stock and recommended that the rationalization of the fishing methods used in this region	
Researcher and discoverer	1974	Sirte gulf	The study was in the central area of the Libyan coast for the purpose of the economic viability of marine fisheries area in the gulf of Sirte the study took place from 22 December 1974 to 12 May 1975, and it resulted to map and identify some of the economic importance of fish gatherings fish and crustaceans'	

			places and sponge in central Libya	
Contrasemix	1976	Eastern region	Study was in the eastern region and operations were limited, because of the nature of the bottom. These included surveys of fish, crustaceans, benthos, sediments, infrastructure, plant animals' plankton and physicochemical factors, in addition to mapping the marine bottoms of the area studied. It also recorded varieties of plants and marine animals known for the first time in the eastern territorial waters of Libya	
Nour	1993 - 1994	Libyan coast	The study was conducted along the Libyan coast, in depths from 50 meters to 300 meters and distance of 12 nautical miles from the coastline and to assess fish stocks and fishing ground in Libya as well as many other field studies on the Libyan coast. Through this project a technical Report was published reports number 30 and 15 field documents containing the results of studies in various project activities and of interest to the development of marine resources and fisheries in Libya	TBN 26, Lamboeuf <i>et al.</i> 1995
Philia	2003	Eastern and Sirte gulf	It had Conducted during August 2003 to evaluate the abundance and distribution of benthic fish, especially the economic species. study area (East and Central) and using the method of bottom trawling and compile information in accordance with criteria and program of international surveys of the shelf benthic Mediterranean (MEDISTS)	Pditou <i>et al.</i> , 2003
Urania	2006	West region	Studying the hydrographic	Bonanno <i>et al.</i> ,

			characteristics and the abundance and distribution of marine plankton fish eggs and larvae's in the project area, which included area extended from the Tunisian border in the west region to the east of Misrata and evaluating biomass and small pelagic fish communities.	2008
Urania	2008	Sirte gulf	This study was conducted for the purpose of identifying the species and distribution of larvae and fish eggs present in Libyan waters in the area extending west from Misrata to Benghazi in the east during the period 15/7/2008 until 31/7/2008	Placenti <i>et al.</i> , 2013
Delaporta	2008	Libyan coast	The use of echo probe (Acoustic) type (EK60) with different wavelengths accomplished during the period 20/8 - 05/09/2008 along the Libyan coast from the Tunisian border in the west to the city of Tobruk in the east for the purpose of biomass for pelagic fish estimate (Mackerel, Sardine, Bouga and anchovies)	
Commercial fishery and fish species composition in coastal waters of Libya	2007	Libyan coast	The number of boats found in this study was 1,511; which 64.3% were "flouka", 24.1% were "mator", 6.9% were "lampara" and 4.8% were "batah", the highest fish species diversity in the coastal area was in the eastern region (45.65%) while in the Gulf of Sirte and western regions the Fig. was 23.91% and 30.43% respectively	Shakman and Kinzelbach, 2007b

#### IV. Conclusions and recommendations

- Identifying of the hotspots and hazards that impacting sea turtles nesting sites
- Changes in biodiversity, several alien species have been added to the national checklist and some of their impacts has been studied
- 131 landing sites of fisheries were recorded along the Libyan coast
- Several habitat hotspots have been identified in the framework of the MedMPAnet and MedPAN projects in 2010, two surveys were conducted in Al-Kouf National Park and Ain Gazalla MPA.
- Determination of important bird sites (IBS)
- Trend of waterbirds in Libya (Atlas of wintering birds of Libya, 2012) available on SPA/RAC website.
- Current situation of the breeding of Lesser Crested Tern
- Hunting, illegal killing and taking of birds. (Preliminary assessment of the scope and scale of illegal killing and taking of birds in the Mediterranean, 2016).
- Illegal fishing gears used along the Libyan coast
- SPA/RAC, EGA-Libya and ICRAM, survey to assess the status of the monk seal population in Libya, the survey started in 2003 and was interrupted in 2009. It involves identifying of resting caves and install camera traps to monitor the species.
- Cetaceans monitoring program in Cyrenaica, a pilot survey took place in 2013 and 2014 to assess the interaction between fisheries and small cetaceans, in 2014 a small scale mark-recapture survey started there and was interrupted.
- 58 species of Cartilaginous have been recorded, and there is no study related to their conservation
- Ecology and biology of some flowing water ecosystems in eastern part of Libya
- Monitoring Mediterranean Lesser Crested Terns *Thalasseus bengalensis emigrates*

## **Needs**

- Capacity building in the different fields of conservation
- Action plan for alien species, comprehensive studies for their impact
- Collaboration between organizations and researchers in the Mediterranean
- Comprehensive studies especially in the sensitive areas, and their conservation
- Establish a regional network and collaboration platforms to exchange the information and experiences.
- Budget and Funding
- Experts specially in the field of invertebrates
- Suitable research vessels and platforms
- The current legislations do not address the new problems of biodiversity (need to be updated), and in some issues, there is no regulations for example legislations for Biosafety.
- Lack of coordination between the organizations and institutions who supposed to implement these legislations as well as the overlapping in their tasks.
- Instability in the administrative bodies and institutions
- Public environmental awareness

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## Annex I

<b>Universities</b>	<b>NGOs</b>	<b>Governmental bodies</b>
Tobruk University	Libyan Society for Artisanal Fisheries Friends (LSAFF)	The Environmental General Authority (EGA)
Omar Mukhtar University	BADO Conservation Society for Marine and Wild Life	Marine Biology Research Centre (MBRC)
Benghazi University	Libyan Youth for Climate	The National Authority of Science and Technology
Ejdabya University	The National Association for the Protection of the Environment	The Marine Wealth Authority
Sirte University	Life Association for the Protection of Marine and Wildlife	
Musrata University	Libyan Society for the Conservation of Wildlife	
Al-Asmarya University	Libyan Birds Society	
Khums University	The Libyan Association for Oceanography	
Tripoli University		
Al-Jafara university		
Sabrata University		
Zawya University		
Zwara University		

## Annex II

### Monitoring Programmes needs and requirements

1. A mechanism or a protocol to gather, store and analyse the data gathered during the monitoring programs. An agreed upon suggestions was to create an online database. The database will have a limited access by the public to view some general information about the habitats and species. The platform can also include GIS maps showing the distribution of certain habitats and species. However, the need for special training and capacity building is needed for a selected team to know more about data entry and analysis. The team also discussed copyright issues for the database and suggested the involvement of a solicitor or a legal adviser who can shade more light into this.
2. Create a list of experts in Libya in relation to each indicator or species, the information on each expert should include; specialization, affiliated organizations and institutes, geographical area of expertise, and contact information.
3. Capacity building for researchers and stakeholders (including NGOs) on how to carry out a successful monitoring programme with a standardized methodology. This step should include translation of field books and survey methods to Arabic.
4. Create a checklist of all equipment and needs for each monitoring programme. The list should note if the equipment are already available in one of the mentioned institutes or organisations, or if they are absent and need to be acquired.
5. Tasks distribution and organisation among the different experts and organisations taking in consideration the geographic and logistic scope.

## Annex III

Selected areas by the Libyan experts. The green written areas refer to the selected MPAs while areas written in red are known to have heavy anthropogenic pressures. The numbers refer to the presence of certain species or habitat types in that area. In the case of Birds, red numbers referred to important nesting areas.

English Area name	Arabic Name	EcAp Common Indicators				
		Habitats present	Marine mammals	Sea turtles	birds	Invasive species
<b>Ain El Ghazala</b>	عين الغزالة	3	3	1+2	3+6	3
<b>Farwa Lagoon</b>	بحيرة فروة	1	1	1+1	3+9	3
<b>Gulf of Sirte</b>	خليج سرت	2	1	1+2	10	4
<b>Gulf of Tobruk to El-Burdy</b>	خليج طبرق الي البردي	2	1	1	3	4
<b>Tripoli Beach</b>	شط طرابلس	1	2	2	11	4
Sabrata	صبراتة	1	1	1+1	11	3
Rass Teen to Derna	راس التين الي درنة	2	2	1	6	3
Zuwaytinah	الزويتينة	0	1	1	1+4	3
Ain Zayana	عين زيانة	0	0	0	5	3